Highly Available OpenStack Deployments with NetApp & Red Hat's OpenStack platform

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Jeff Applewhite
Technical Marketing Engineer, Cloud Solutions Group, NetApp
Introductions
Introduction

Jeff Applewhite

- Technical Marketing Engineer, Cloud Solutions Group
- 5 Years at NetApp, 2.5 Years on OpenStack Engineering team
- ATC on various OpenStack projects
Agenda

1) Introductions
2) NetApp OpenStack Integrations
3) Red Hat and NetApp OpenStack collaborations
4) Deploying RHEL-OSP and NetApp in an HA configuration
5) FlexPod: Cisco, Red Hat, and NetApp unlocking business value
6) Q & A
OpenStack 10,000 Foot View

- Every release is getting better
  - New features released on regular 6 month cadence
  - Excellent quality through automated CI/CD DevOps processes
    - Version upgrades are becoming easier
- Installation toolsets are Enterprise Ready
  - HA Production Deployments are on the rise
  - The ease of deployment and configuration of NetApp Cinder from RHOS5 → RHOS6 has greatly improved.
  - GUI configuration of NetApp now works “out of the box”.
The NetApp OpenStack Story

Overview
NetApp OpenStack Involvement

- OpenStack Foundation
  - Charter member (Gold)
  - OpenStack Summit sponsors

- 1st Major Storage Provider in Community
  - Upstream Contributions
  - Numerous Production Deployments
  - NetApp is a Deployer of OpenStack
NetApp & OpenStack Deployment
Adoption Accelerating

285% Growth in Deployed Systems

152% Growth in Deployed Customers
Integration Overview

Manila

- **Compute**
- **Networking**
- **Block Storage**
- **Object Storage**
- **Image**
- **Shared Files**

**Clustered Data ONTAP**
- **Shared File Systems**
- **Persistent, rapid, space-efficient instances**
- **Block Storage**
- **Object Storage**
- **Image**

**E/EF-Series**

**FlashRay**

**StorageGRID WebScale**

NetApp
# NetApp’s Core Competencies

## FAS
- **Continuous Operations**
- **Seamless Scaling**
- **Storage Efficiency**
- **Data Mobility**
- **Data Protection**
- **Unified Architecture**
- **Quality of Service**
- **Service Automation**
- **Secure Multi-Tenancy**

## E-Series
- **Simplicity**
- **Horizontal Scaling**
- **Consistency**
- **Density**
- **Versatility**
- **Vast Bandwidth**
- **Broad Connectivity**
- **Data Mobility**
- **All-Flash**
Glance

- **Rapid Cloning**
  - **Copy offload** eliminates first network copy from Glance to Cinder host
  - NFS image cache used for subsequent clones.
    - In testing we can FlexClone 20GB in 0.3 second!

- **Space Efficiency**
  - **Deduplication**: Common 4k blocks are coalesced into a single block
  - When used on Glance image store FlexVol, storage footprint is reduced dramatically
    - Up to 90% disk savings
Cinder deployment with NetApp

Diverse Options for Diverse Use Cases

- **FAS**
  - Clustered ONTAP
  - 7-mode

- **E-Series**
  - E-Series
  - EF-Series

- **pNFS**, **FC**
- **NFS**
- **iSCSI**

* = planned for Kilo release
Deliver workload-aligned block storage offerings
Create a storage service catalog that maps the differentiated features of Data ONTAP to Cinder

- Map features of underlying NetApp storage to create classes of service
  - Aligned to workloads – for example:
    - Database needs high IOPS with Flash, and data protection
    - Temporal workloads need thin provisioning and deduplication

- Ensure that consumption matches intent
  - Show back, chargeback, etc.
Swift
Advantages of NetApp E-Series arrays

- Resiliency
  - As disk sizes increase, so do rebuild times after failure
  - With E-Series DDP, rebuild operations are 8x faster
    - Rebuild traffic offloaded from network to backend storage

- Efficiency of Swift?
  - Swift replicates data 3x times across cluster by default
    - Weight of replication traffic can become limitation to scale
    - As Swift scales, hardware requirements increase linearly

- With E-Series
  - Data replication can be reduced to 1.3x on disk locally
  - Less hardware is needed leading to lower rack space, power, & cooling requirements

NetApp E-Series DDP
- Dynamic distribution / re-distribution of data “De-clustered” RAID
- Evolution of CRUSH (erasure coding)
- Space and scaling efficiency
- 7 Patents applied for
Swift on NetApp E-Series
Efficient Storage and Scaling with Dynamic Disk Pools

- Dynamic distribution / re-distribution of data: De-clustered RAID
- Deploying Swift with NetApp E-Series reduces:
  - Required storage capacity
  - Ongoing cost of operations
  - Deployment footprint
  - Replication traffic between Swift nodes

DDP reduces disk rebuild times by 90%
Red Hat and NetApp joint efforts in RHEL-OSP6

- Regular syncs to provide for consistency of roadmap and vision
- Puppet modules for managing the Cinder NetApp driver have been integrated in RHEL-OSP since release 5
- The RHEL-OSP installer now has the NetApp Cinder driver exposed in the Cinder GUI deployment pane (RHEL-OSP 6 A1 hotfix or native to RHEL-OSP6 A2 release)
- NetApp internal IT and Engineering OpenStack deployments are live on RHEL-OSP
- Aligning efforts with development teams: Features, bugs, and priorities
- Support – Drivers are certified via Red Hat test suite
Highly Available Deployments of RHEL-OSP 6 and NetApp Storage
Solution Overview

FAS
Solution Overview

E-Series
Deployment Choices:
- High Availability
- Networking Subsystem
- Messaging Provider
- Passwords
Networking Choices:

- Click New Subnet to create networks
- Drag Networks to their proper location
New OpenStack Deployment

Cinder Service Configuration

Choose Driver Backend

- NFS
- LVM
- Ceph
- EqualLogic
- NetApp

Storage System #1

- Storage: Clustered Data ONTAP
  - Family: Data ONTAP 7-mode
  - E-Series
- Storage Protocol: NFS
- Hostname: 10.250.117.106
- Login: admin
Storage System #1

- **Storage Family:** Clustered Data ONTAP
- **Storage Protocol:** NFS
- **Hostname:** 10.250.117.106
- **Login:** admin
- **Password:** ********
- **Server Port:** 443
- **Transport Type:** https
- **NFS Shares:** 172.20.2.18:/vol/cinder
- **NFS Shares Config:** /etc/cinder/shares-nfs.conf
- **Storage Virtual Machine (SVM):** openstack
# HA OpenStack with High Availability

## Deployed (0)  Assigned (5)  Free (2)

## Assigned Hosts

<table>
<thead>
<tr>
<th>Name</th>
<th>Deployment Role</th>
<th>CPUs (cores)</th>
<th>Memory (GiB)</th>
<th>Storage</th>
<th>NICs</th>
<th>IP Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>inac901b0e0x398a36.netapp.corp</td>
<td>Compute (Neutron)</td>
<td></td>
<td></td>
<td></td>
<td>e1001</td>
<td>10.250.118.9</td>
</tr>
<tr>
<td>inac901b0e0x366e.netapp.corp</td>
<td>Compute (Neutron)</td>
<td></td>
<td></td>
<td></td>
<td>e1001</td>
<td>10.250.118.7</td>
</tr>
<tr>
<td>inac901b0e0x3958.netapp.corp</td>
<td>HA Controller</td>
<td></td>
<td></td>
<td></td>
<td>e1001</td>
<td>10.250.118.6</td>
</tr>
<tr>
<td>inac901b0e0x3959c.netapp.corp</td>
<td>HA Controller</td>
<td></td>
<td></td>
<td></td>
<td>e1001</td>
<td>10.250.118.4</td>
</tr>
<tr>
<td>inac901b0e0x38e.netapp.corp</td>
<td>HA Controller</td>
<td></td>
<td></td>
<td></td>
<td>e1001</td>
<td>10.250.118.5</td>
</tr>
</tbody>
</table>
Drag networks to the bond0 interface which has 2x 10GbE NICs.

Note: 802.3ad performed best in our tests with no port errors. See referenced deployment guide for configuration details.
Lessons learned

- **Check Twice, Deploy Once**
  - Verify networking: Verify that the installer and the physical network is correctly setup.
  - Pay close attention to iptables and routing setup on installer.
  - While testing deployments you can prevent Puppet from overriding your changes by setting the immutable flag on a file ex. # chattr +i /etc/cinder/cinder.conf

- **Start Simple**: Test with a single controller node and ensure this basic build is successful.
  - Delete deployment, delete discovered hosts and start again.
  - A successful build will stay at 30% quite long. Watch top to see yum, puppet, and then later OpenStack processes running on the node.

- **If Deployment Fails**: Troubleshoot failed nodes on the console of the node
  - # puppet agent -t --debug
  - Look at advanced section of deployment to see how variables evaluate. Correct errors.
Enterprise Deployments

Why FlexPod for Red Hat Enterprise Linux OpenStack Platform 6?
FlexPod Platform

- Converged Infrastructure solution developed by NetApp® and Cisco®
- NetApp FAS, Cisco UCS® and Cisco Nexus® switch components
Verified and Validated Architecture

Cisco® Validated Design (CVD)
NetApp® Verified Architecture (NVA)

- Detailed planning stage
- Collaborative design
- End-to-end validation
- Consistent documentation
OpenStack on FlexPOD

- Speed up Cloud Deployment
- Deliver on Enterprise SLAs
- Increase Cloud Reliability
- Improve Security and Compliance
- Reduce Cloud Implementation Risks
- Take Advantage of Comprehensive Cloud Support
- Create an Open Hybrid Cloud Foundation
FlexPod: Full-Stack Best of Breed

- **Compute**
  - Server abstraction with Cisco UCS Service Profiles for easily scalable systems
  - iSCSI SAN boot eliminates local drives in compute nodes for stateless booting
  - Enterprise-class hypervisor with RHEL KVM

- **Networking**
  - Industry standard and feature-leading Cisco Nexus switching
  - OpenStack Neutron ML2/VXLAN or ML2/Nexus modular drivers in RHEL-OSP

- **Storage**
  - NetApp Cinder driver configured automatically with RHEL-OSP Installer
  - Unified, scale-out storage: block, NAS, hybrid, all-flash
  - Swift Object Storage on NetApp E-Series array
FlexPod: High Availability Out of the Box

- Redundant components
  - Multipath everywhere
  - Dual fabrics
  - Dual storage and network infrastructure devices

- Seamless Upgrades
  - Cisco UCS firmware for compute and network
  - NetApp Data ONTAP OS and firmware for storage

- Nondisruptive Operations
  - Live migration of storage interfaces and volumes across cluster
  - On-line expansion and contraction of compute and storage clusters
FlexPod: Scaling Up and Scaling Out

- **Compute**
  - Up to 4 CPUs per server
  - Up to 6TB RAM per server
  - Up to 160 half-width servers in a single UCS domain
  - Multi-UCS domain management with UCS Director

- **Storage**
  - Up to 8.4PB in a single HA pair
  - Up to 33PB in a SAN or hybrid cluster
  - Up to 101PB across a NAS cluster
  - Up to 250 SVMs in a SAN cluster or 1,000 SVMs in a NAS cluster
## Scale Testing
Comparison with a competitor’s published numbers

<table>
<thead>
<tr>
<th>Action Description</th>
<th>Competitor</th>
<th>Data ONTAP</th>
<th>Percent Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boot 200 Instances with 100GB Cinder Volumes</strong></td>
<td>37 Minutes With 15 Compute Nodes</td>
<td><strong>Clone and Boot 1000 Persistent Instances:</strong> 31 minutes!</td>
<td>89%</td>
</tr>
<tr>
<td><strong>Delete 200 Instances and Cinder Volumes</strong></td>
<td><strong>10 Minutes</strong></td>
<td></td>
<td>88%</td>
</tr>
<tr>
<td><strong>Boot 1000 Instances with 100GB Cinder Volumes</strong></td>
<td>150 minutes With 15 Compute Nodes</td>
<td><strong>6.4 Minutes</strong></td>
<td>83%</td>
</tr>
<tr>
<td><strong>Delete 1000 Instances and Cinder Volumes</strong></td>
<td><strong>17 Minutes</strong></td>
<td></td>
<td>62%</td>
</tr>
</tbody>
</table>

*Source: NetApp RTP Testing*
HA Reference Architecture
Available today!

- **TR4323-DESIGN**: “Highly Available OpenStack Deployments Built on NetApp Storage Systems”
  - Solution Design document based on Icehouse
  - Includes best practices for networking, storage, high availability

- **TR4378-DEPLOY**: “Red Hat Enterprise Linux OpenStack Platform 5 on NetApp Clustered Data ONTAP”

- **Follow us on Twitter for @openstacknetapp**
  - Also NetApp’s OpenStack blog: [http://netapp.github.io/openstack/](http://netapp.github.io/openstack/)
Questions?